Research Division

Tools for Better Transportation Tomorrow

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What's HOT

MONTICELLO IN-PLACE COLD MIX RECYCLED ASPHALT BASE USING SOLVENTLESS EMULSION

By: Richard Sharp, UDOT Research Division

The project is located east of Monticello, Utah on US 491 and consists of total pavement reconstruction, shoulder widening and the addition of passing lanes. The pavement reconstruction is performed by a cold mix recycling of the existing pavement and a 6” hot mix asphalt overlay to be topped in 2008 with a chip seal for improved skid resistance and to minimize hydroplaning.

LaGrand Johnson Construction began placing the cold mix recycled asphalt base using the old in place asphalt.

The project was observed by UDOT Research July 31, 2007for a few hours. Many pictures were taken to share with the UDOT Regions and other interested parties.

The process begins by roto-milling 3 inches of old asphalt pavement, and sizing it through a screening plant. Once it is sized, solventless emulsion, quick lime and water are added and mixed to design proportions determined by the contractor. The material is then windrowed and a conventional asphalt pickup machine and paver process it as you would a hot mix asphalt. The solventless emulsion allows the compaction to begin within minutes of the placement. Considerable time savings is created by using the solvent less emulsion. The compactive effort was performed by two steel wheel/rubber, vibrating rollers and a rubber tired static roller was used to complete the densification process.

Production rates for this process achieved 8,000 LF per day on a 14’ wide section of roadway (half the roadway width) at the 3” recycled cutting depth. The recycling process at this production rate results in a time for completion of the recycling at close to 12 days of production. The production equates to around 900 ton per day of recycling.
Traditional construction, excavation, borrowing and untreated base placement for this project is estimated to take about 60 days to complete. Time is money!

A cursory comparison between the traditional process and the cold-in place recycling method used in this project indicates that an estimated savings of $200,000 was realized.

Traffic was allowed on the recycled pavement to accommodate the traffic control and exhibited virtually no degradation.

Historically, cold mix recycling has been performed primarily in Region Four. Research Study on I-15 from Paragonah to Cedar City determined that the process was successful and the resulting pavement section was equal to or better than the traditional hot mix asphalt section. Keep in mind that recycling has “keep it green” in mind. Cold mix recycling reduces the amount of asphalt oil in a project and utilizes the existing asphalt and aggregates for a significant cost savings. It also reduces the amount of energy and product required. For more information, please contact Barry Sharp @ rsharp@utah.gov.

STILL WATCHING I-15: PART 1- MSE WALLS

By: Blaine Leonard, UDOT Research Division

Many people remember that during the early construction efforts on the I-15 Reconstruction Project in Salt Lake County, a large and far-reaching research effort was initiated. This unprecedented research effort, known as the I-15 National Test Bed for Transportation Research, ultimately involved 31 research projects supported with $4.67 million of special, dedicated funding. A joint effort by UDOT, FHWA, Utah State University, University of Utah, Brigham Young University, and a variety of private consultants and contractors, the I-15 Test Bed has yielded vast amounts of engineering and construction data. While most of these projects are completed, some of these research efforts are still on-going. This article, the first in a series, summarizes the efforts initiated as part of the I-15 Test Bed to evaluate the performance of Mechanically Stabilized Earth (MSE) walls, some of which are still underway.

One of the chief design and construction challenges faced during the I-15 Reconstruction was the widening of large earth embankments within limited right-of-way over very soft, compressible subsoils. Designers and contractors met this challenge with a variety of innovative techniques and materials, including light-weight fill, expanded polystyrene (EPS Geofoam) fill, one-stage and two-stage MSE walls, lime-cement column soil stabilization, prefabricated vertical (PV) drains (wick drains), and fairly conventional surcharging. UDOT initiated a long-term monitoring program to evaluate many of these innovative techniques, and this monitoring program is still underway. The program involved the placement of a variety of measuring devices, such as survey points, vertical and horizontal inclinometers, pressure sensors, strain gages and magnet extensometers.

MSE walls were used on this project as a quick and efficient way to build vertical retaining walls within limited right-of-way. One-stage walls, where the precast concrete facing panel is erected as part of the wall, and two-stage walls, where the wall is built without the permanent facing and the panels are erected later, were constructed in many locations along the corridor. About 160 MSE walls were built as part of this project, some as high as 30 feet.

A variety of research efforts were initiated relative to MSE walls. Dr. Jim Bay and Dr. Loren Anderson, from Utah State University, with several graduate students, instrumented a 30-foot wall at about 3600 South. They evaluated the stresses and displacements within the wall, the performance of the reinforcing within the wall, and the influences of the wall on the ground and structures in the wall vicinity. In a report published in 2003, they concluded that the MSE wall reinforcing mats were experiencing only 20% of the anticipated tension forces and that intermediate reinforcing layers were useful in controlling deformation during early settlement but were not necessary for overall wall stability. They found that the lateral soil loads behind the wall were less than the design loads, that the wall essentially moved as a rigid body, without much internal deformation, and the settlements beneath the wall were within anticipated limits. In a subsequent report, published in late 2004, Utah State described a detailed analytical model of the MSE wall at 3600 South. Their analysis pointed out the relationship between construction sequencing, construction timing, and wall stability. They recommended the use of finite element modeling of these walls to accurately assess the failure modes and safety factors.

Dr. Steven Bartlett, at the University of Utah, also has provided insights into the performance of MSE walls. A 10-year monitoring program of the I-15 geotechnologies, initiated while Steve was a project manager with the Research Division, included two MSE wall sites. Measurement of settlement and ground deformation is still underway, and will continue until 2011. Another former Research Division project manager, Clifton Farnsworth, continues to be involved in this effort. A modeling report issued in 2006 describes the effects on nearby structures from these large walls. Among other things, it concludes that the zone of significant settlement in front of an MSE wall founded on soft soil can be on the order of 1.3 times the height of the wall, and recommends that existing structures within that distance be avoided or mitigated. The study further outlines some advanced modeling techniques that can be used to understand the behavior of these walls.

Efforts to limit settlement beneath the MSE walls included the use of lime-cement columns. The acceleration of settlements beneath MSE walls often involved PV drains. The University of Utah studies evaluated both of these techniques, their effectiveness and relative costs. A paper about to be published in the ASCE Journal of Geotechnical and Geoenvironmental Engineering concludes that the one-stage MSE wall with lime cement columns is approximately 1.6 times more expensive than a two-stage wall with surcharging and PV drains, but that the two-stage approach caused more settlement impact to adjacent structures. The advantages and disadvantages of each of these approaches is valuable information as we continue to include MSE walls in our design and construction projects. During the next four years, as these MSE walls are monitored further, we will gain additional insights into the long term settlements of these walls, the ground deformations in adjacent areas, and the performance of the walls.

In a related effort, new projects are underway at Utah State and Brigham Young Universities to evaluate the performance of MSE walls. Although not directly related to the I-15 project, these studies are an outgrowth of the information gained from I-15 Test Bed projects. This current effort involves inspecting many of the existing MSE walls around the state, performing a risk analysis of the possible modes of failure in these walls, and developing a plan to mitigate the risk of failure in these walls. In addition, an analytical study of MSE walls will attempt to identify the potential impacts of deformation within the wall on pavement surfaces. Stay tuned for the results of these studies.

So, we are still watching, learning, and building upon the vast research effort undertaken during the I-15 Reconstruction. MSE walls were just one element of the innovative design and construction efforts undertaken and evaluated. We will continue our efforts to better understand these walls and how to employ them more efficiently. For more information, please contact Blaine Leonard bleonard@utah.gov or 801-965-4115.

UDOT'S BIODIESEL INTITIVE: LESSONS LEARNED TO DATE

By: Monica L. Gonzalez, UDOT Communications Office

Earlier this year, Utah Department of Transportation (UDOT) announced an experiment to grow biodesel producing crops such as safflower, canola and perennial flax and to generate bio-diesel as a source of fuel for its fleet. This experiment was to be conducted in partnership with Utah State University (USU). In May, UDOT seeded these crops on its rights-of-way along Utah's I-15 in Kaysville, Tremonton, Mona, and at Mile Marker 240. Once harvested, the crops would be processed by USU to obtain the bio-diesel fuel.

"UDOT is a national pioneer in this (bio-diesel experiment)," said Dallas Hanks, with USU. "This is something we never even thought about doing."

Before the seeds could be planted, there were things to consider, such as whether conditions would permit crops to grow along freeway shoulders, what environmental problems would arise, such as erosion, how soil conditions would be affected, and what would happen to the weed population along the highway. Preparation for the actual planting came after creating an economic model, selecting staff, sites and crops to be used. Existing vegetation on the right of way was killed, and machinery was selected for use during the planting process.

UDOT and USU were hoping to see results by this fall.

After monitoring the crop areas, it was found the crops did not do as well as UDOT and USU had hoped for. "I wouldn't call this a failure," said Dallas "we have learned a lot and know what changes need to be made. We knew the first year would be about learning what can be done, and how best to get it done."

The best producing area was the right of way along I-15 in Kaysville, with a Canola emergence rate of 35%. "The fact that we got some emergence in this weather is very positive. We were 45 days past prime planting time; late planting combined with above average temperatures and low moisture created some unfavorable conditions, but when compared to a local canola farm, there was very little difference in the amount produced; that is very encouraging."

Among the lessons learned, one of the most significant was the depth of the planting. "We understood that ¾ of an inch was deep enough for the seeds, but at that depth, the seed basically just lay there, no moisture was getting to it from the ground and with no rainfall, there was no germination. We have learned that the seed needs to be at least 1 ½ inches deep, but deeper than 3 inches would be better because these seeds have a tap root and will mine for water. The control plot got fairly good germination, and those seeds were 8-10 inches deep," said Dallas. "We learned the soil conditions are acceptable and we can plant on it, but there are things we can do to help."

Dallas mentioned research being done by Michigan State using an industrial size aerator type of machine which makes an indentation in the ground 3 to 4 inches deep, about 7 inches apart. They then use manure slurry to create a planting pot for each seed, the organic matter plus the moisture make for an outstanding planting method, which produces a very good yield.

"We are working with some waste water treatment plants to create something similar, but we would use bio-solids slurry, which we would inject under the soil, as well as on top. The idea is to plant and fertilize the seed all at once" said Dallas. "We are meeting with the Department of Environmental Quality (DEQ) to see if we can get approval to use bio-solids."

"There has been such a great response to this experiment, from the media as well as corporations and private individuals over the last few months" said Dallas "we have received over 400 e-mails each month and the phone message box has been full every week."